

INTRODUCTION

Each year, approximately 26,000 Californians with advanced heart disease undergo a major surgical procedure known as coronary artery bypass graft (CABG) surgery. In California, 119 hospitals offer bypass surgery to adult patients. Prior to the establishment of the **California CABG Mortality Reporting Program (CCMRP)** and the release of its first report in July 2001, little was known about how well California hospitals performed this surgery. Such information is critical for hospital quality improvement efforts and for enabling patients and their families to make informed decisions about where to receive care that is effective and safe.

In 1995, the Pacific Business Group on Health (PBGH) and the California Office of Statewide Health Planning and Development (OSHPD) established a voluntary statewide reporting program to collect mortality data from California hospitals and to publicly report the performance results on this key marker of clinical quality. This summary report, and its companion ***The California Report on Coronary Artery Bypass Graft Surgery 1999 Hospital Data: Technical Report***, continue our series of public reports showing the performance results for California hospitals that perform bypass surgery.

The CCMRP **1999 Hospital Data Summary Report** presents findings from analyses of data collected from 70 of California's 119 hospitals that regularly performed CABG surgery during 1999, and focuses on in-hospital mortality as the key outcome measure.² The report includes results for the single calendar year 1999 (**1999 Analysis**). The **1999 Analysis** includes a total of 21,973 cases from all hospitals that submitted data to CCMRP for 1999, making it the largest public reporting program on CABG outcomes in the United States. The report also includes results from a roll-up of all continuous quarters of data submitted by hospitals since they joined CCMRP (**All Quarters Analysis**)—a period representing from one to three years' worth of data between 1997 and 1999 for each participating hospital.³

KEY FINDINGS

- In the single year **1999 Analysis**, the overall in-hospital death rate in California among participating hospitals was 2.76% for 1999 (meaning slightly fewer than 3 deaths per 100 cases). Nationally, the Society of Thoracic Surgeons reports an “operative mortality” rate for isolated bypass surgery of 2.90% for 1999.⁴

Most California hospitals (67 of 70) performed “as expected,” meaning the actual death rates at these institutions were within range of what was expected given the complexity of cases they treated. Three of the 70 hospitals performed significantly “worse than expected,”

² In-hospital mortality means the patient expired prior to discharge from the hospital that performed this operation, regardless of length of stay. Deaths are not counted after discharge even if the patient dies soon after the operation. If a patient is transferred post-operatively to a rehabilitation or transitional care facility and dies before going home, this death is not counted.

³ CCMRP began enrolling hospitals in the program starting January 1, 1997. Enrollment in the program was ongoing during the 1997-1999 period. As a result, hospitals continuously participating since their enrollment in the program will have different numbers for their “quarters of participation.” The maximum number of quarters of participation for any one hospital is 12—representing full year participation in 1997, 1998, and 1999. The minimum number of quarters of participation required for inclusion in this report is four, representing full calendar year 1999. Results for 1997-1998 data can be found in the report published by CCMRP in July 2001.

⁴ Operative mortality refers to 30-day mortality. Most deaths “in-hospital” occur within 30 days. The “operative mortality” rate tends to be slightly higher than the “in-hospital” mortality rate.

meaning their actual death rates were higher than expected given the complexity of cases they treated. The three hospitals were Desert Regional Medical Center, Marin General Hospital, and Scripps Mercy. None of the 70 hospitals performed significantly “better than expected,” meaning that no hospital’s actual death rate was lower than expected given the complexity of cases they treated.

It is too not surprising that there are no “better than expected” performers in the analysis of the 1999 data. This is due to the very low mortality rate associated with bypass surgery (fewer than 3 deaths for every 100 cases in 1999) and the wide confidence intervals around the estimates of 1999 performance for a large share of California hospitals with low annual volumes of CABG cases. These factors make it very difficult for hospitals to distinguish themselves as “better than expected” performers when looking only at a single year’s worth of results.

- In the multi-year **All Quarters Analysis**, representing from one to three years’ worth of data between 1997 and 1999 for each of the 70 participating hospitals, the overall in-hospital death rate was 2.60%. Because the **All Quarters Analysis** represents more cases for each hospital (save those with 1999 data only)⁵, it allows for greater precision in estimating each hospital’s performance (this means smaller confidence intervals around each hospital’s expected death rate) and increases our ability to distinguish performance differences among hospitals. The aggregation of data over multiple years is especially important for evaluating the performance of small volume hospitals, whose mortality experience tends to be more variable year-to-year.

The **All Quarters Analysis** revealed that of the 70 hospitals publicly reporting, five hospitals performed “better than expected,” 59 hospitals performed “as expected,” and six hospitals performed “worse than expected.”

- **“Better than Expected” hospitals**—Doctor’s Medical Center-San Pablo, Heart Hospital of the Desert, Scripps Memorial Hospital, Summit Medical Center, and Sutter Memorial Hospital.
 - **“Worse than Expected” hospitals**—Alta Bates Medical Center, Desert Regional Medical Center, Marin General Hospital, Memorial Medical Center of Modesto, Presbyterian Intercommunity Hospital, and Scripps Mercy.
- The expected death rate ranged from 1.2% to 5.4%, revealing wide variation among California hospitals with respect to the case mix of patients they treat. This underscores the importance of adjusting for differences in case mix to produce outcome scores.
 - The public has reason to be concerned about the performance of the 49 non-participating hospitals. First, our evaluation of the relationship between the volume of CABG procedures a hospital performs and in-hospital mortality shows that, on average, CCMRP hospitals with mean annual volumes of *fewer than 200* cases experienced statistically significantly higher mortality than hospitals with *300 or more* cases annually. This finding raises concerns about the performance of hospitals whose results do not appear in this report, especially since 35 of the 49 non-participants had annual surgical volumes of *fewer than 200* cases.

Second, based on data from OSHPD’s Patient Discharge Database (PDD), the “raw” *unadjusted* mortality rate for the 49 hospitals that declined to participate in CCMRP was

⁵ Twelve hospitals began participation in 1999; their All Quarters rate thus reflects performance solely for that single year.

3.34% in 1999 compared to 2.73% for the 70 participants⁶. Of the 49 non-participants, 11 submitted usable data but were either dropped (2 hospitals) or withdrew (9 hospitals) prior to publication of this report. The *unadjusted* in-hospital death rate for these 11 hospitals was 3.21%. Non-participants tended to have worse performance results than did participants, which underscores the importance of compulsory reporting for all hospitals.

THE NEED FOR COMPARATIVE OUTCOME INFORMATION

CABG surgery is a frequently performed and costly procedure. Based on data from OSHPD's 2001 PDD, 25,932 isolated⁷ coronary artery bypass graft surgeries were performed at 119 California hospitals. For 2001, the average hospital charge for a bypass procedure was approximately \$129,770 (OSHPD, 2001).⁸ For some hospitals, only births comprised a larger proportion of their total revenue.

Patients and employers—who often serve as purchasing agents for employee and dependent populations—face difficulties in making informed healthcare purchasing and treatment decisions. Rarely is comparative information on health outcomes readily available to help guide consumer and purchaser choice in the marketplace. This is particularly true for information about hospital performance. Consequently, purchasing and treatment decisions typically are based on price alone and not on the overall value of services—a key component of which is the quality of care as measured by outcomes and adherence to evidence-based practices.

The development of narrow and tiered hospital networks by health plans underscores the importance of having reliable performance information to distinguish hospitals on their overall value to consumers. In the absence of outcomes data, plan decisions about which tier a hospital is placed into will largely be determined by price—which neither benefits patients nor rewards better performing hospitals. Moreover, patients typically are referred to a hospital for surgery based on a recommendation from their cardiologist; rarely do outcome information or proxy measures of performance such as the number of procedures a hospital performs factor into the decision.

Most importantly, in our efforts to promote the delivery of high quality care, there is a need among California hospitals and surgeons for comparative performance data. This type of information is lacking for all hospital procedures with the exception of bypass surgery and acute myocardial infarction. Performance information is vital to help hospitals understand where quality of care problems may exist and to target improvement efforts. Measurement and public accountability are powerful stimuli in driving quality improvements in all sectors, including healthcare (Hibbard et al., 2003).

⁶ Calculations of observed mortality rates differ slightly depending on the data source. When comparing CCMRP non-participating hospitals to CCMRP participants, it was necessary to utilize data from OSHPD's PDD. All other analyses are based on data submitted directly to CCMRP from participating hospitals.

⁷ Isolated means no patient received both a CABG and an additional major procedure such as a valve repair or replacement during the same operation. Isolated CABG surgeries comprise the majority of heart operations in California and the U.S.

⁸ Calculations refer to total charges per discharge for an isolated CABG procedure. Few hospitals actually receive payment in the amount represented by charges. Reimbursement rates are negotiated between health plans and hospitals and typically are much lower than charges.

By making hospital-level performance results on bypass surgery publicly available, CCMRP seeks to provide comparative outcome data to multiple end-users:

- **Hospitals and their clinical teams**—to stimulate and facilitate quality review of surgical procedures and processes of care that will lead to improved outcomes.
- **Physicians**—to help guide referrals of patients to hospitals and cardiac surgery teams with good surgical outcomes.
- **Purchasers of care**—to assess hospital performance and incorporate quality measures in their benefit designs and purchasing decisions.
- **Patients and family members**—to enable them to understand differences in treatment outcomes across various hospitals to allow for more informed choice of hospital.

DESCRIPTION OF THE REPORTING PROGRAM

CCMRP is a voluntary statewide hospital-reporting program that collects and reports on CABG operative mortality at the hospital level. CCMRP produces uniform, hospital-level mortality rates, adjusted to account for differences across hospitals in the mix of patients undergoing CABG surgery.

Hospital Participation

All 119 California hospitals that performed at least 25 adult CABG surgeries in 1999 were formally invited to participate in the program. Among these 119 institutions, 70 hospitals agreed to submit data, participate in the audit and publicly report their results, while 49 hospitals did not participate for various reasons. A complete list of hospitals eligible to participate in CCMRP and their participation status can be found in Appendix A of this report.

Hospitals that participated in CCMRP were asked to submit 41 data elements that described the demographic characteristics and pre-operative condition (risk factors) for each patient who underwent an isolated CABG procedure at their hospital. The data elements were selected after a thorough review of the clinical literature on risk predictors for bypass surgery and an examination of variables collected by the leading cardiac reporting programs. With some clarifications, CCMRP draws on a subset of data elements collected by the Society of Thoracic Surgeons (STS) for their National Database of Cardiac Surgery.

For the **1999 Analysis**, the 81 hospitals that initially submitted data provided 21,973 usable records to CCMRP. Of the 81 hospitals, 68 had previously submitted data for all or parts of 1997 and/or 1998.⁹ As such, the **All Quarters** dataset containing combined rolled-up data across multiple years represents a total of 49,823 cases. All hospitals shown in this report submitted a minimum of four quarters of data for 1999.

⁹ Enrollment in CCMRP is ongoing and hospitals can join at any time. Consequently, participants have varying numbers of quarters of data submissions, depending on the date they joined CCMRP.

Data Quality Review

CCMRP used various strategies to evaluate the data submitted from each hospital for completeness and potential data errors. CCMRP engaged in the following steps to clean and verify each hospital's data submission:

- Produced hospital-specific data reports highlighting coding issues for hospitals to review and take actions to correct;
- Linked the CCMRP record to OSHPD's PDD to evaluate the accuracy of isolated CABG case submission and patient *Discharge Status* (alive/dead), with phone follow-up to hospitals to resolve resulting issues;
- Conducted a medical record audit of a subset of cases at 36 hospitals and replaced missing/inconsistent data with audited data;
- Imputed any residual missing or invalid data values.

Two hospitals that refused to undergo the audit and two hospitals with significant data problems that they were unable to fix were dropped from the program.

Readers interested in a more thorough explanation of the data collection, cleaning, audit and verification processes should refer to ***The California Report on Coronary Artery Bypass Graft Surgery 1999 Hospital Data: Technical Report*** (PBGH and OSHPD, 2003).

ADJUSTING THE HOSPITAL MORTALITY DATA FOR PATIENT MIX

Patients treated at different hospitals may vary in the severity of their pre-operative clinical condition. To fairly compare outcomes at different hospitals, it is necessary to adjust for differences in the case mix of patients across hospitals. CCMRP "levels the playing field" by accounting for the pre-operative condition of each patient using a multivariate logistic regression model. The risk model evaluates the relationship between each of the demographic and pre-operative risk variables and the likelihood of in-hospital mortality. Hospitals that routinely handle complex cases (i.e., sicker at the time of admission) get a larger risk-adjustment weighting in the risk model, while hospitals that handle less complex cases get a smaller weighting. CCMRP intentionally included as risk-adjustment variables only those data elements that describe the patient's condition prior to the heart bypass procedure.

Several statistical tests were performed to assess how well the model fit the data. The tests showed a high degree of agreement between the actual number of deaths at each hospital and the number of deaths predicted for that hospital when using the risk-adjustment model. This means the risk model gives hospitals appropriate credit for treating more complex cases. Consequently, hospitals and surgeons should not exclude high-risk patients from appropriate CABG surgeries as a means to improve performance scores.

Readers interested in a more thorough explanation of the risk-adjustment methods used should refer to ***The California Report on Coronary Artery Bypass Graft Surgery 1999 Hospital Data: Technical Report*** (PBGH and OSHPD, 2003).

COMPARISON OF CCMRP PARTICIPANTS TO NON-PARTICIPANTS

The voluntary nature of CCMRP begs the question: are the mortality rates of non-participating hospitals substantially different from those that participated? Because non-participants did not submit the clinical data necessary to adjust for differences in the case mix of patients across hospitals, a direct comparison of *risk-adjusted* mortality rates between CCMRP participants and non-participants is not possible.

However, CCMRP was able to utilize data available from OSHPD's PDD to calculate the "raw" or *unadjusted* death rates for both participating and non-participating hospitals. As presented in the table below, the overall death rate of 3.34% among non-participating hospitals is statistically significantly higher than the overall death rate of 2.73% among CCMRP participants.¹⁰ Also, in all but one volume category, the *unadjusted* death rate is higher among the non-participating hospitals as compared to CCMRP participating hospitals. However, this difference was found to be statistically significant only in the *100 or fewer* category (4.20% for non-participants vs. 2.45% for participants).

**Comparison of Unadjusted Mortality Rates:
CCMRP Participating Hospitals vs. Non-Participating Hospitals**

Volume	Participants		Non-Participants	
	Number Hospitals	Death Rate	Number Hospitals	Death Rate
under 200	35	3.29	35	4.03
200 to 299	19	3.33	6	3.32
300 to 599	12	2.23	7	3.55
600 or more	4	2.06	1	0.47
Total	70	2.73 ¹¹	49	3.34

Source: OSHPD, PDD, 1999.

THE RELATIONSHIP BETWEEN HOSPITAL VOLUME AND MORTALITY

A number of studies have found a statistically significant relationship between the annual number of bypass surgeries a hospital performs and mortality (Farley, 1992; Hannan et al., 1989; Hannan et al. 1991; Showstack et al., 1987; Dudley et al., 2000). On average, hospitals

¹⁰ Based on Fisher's exact test for differences, p-value = 0.0054.

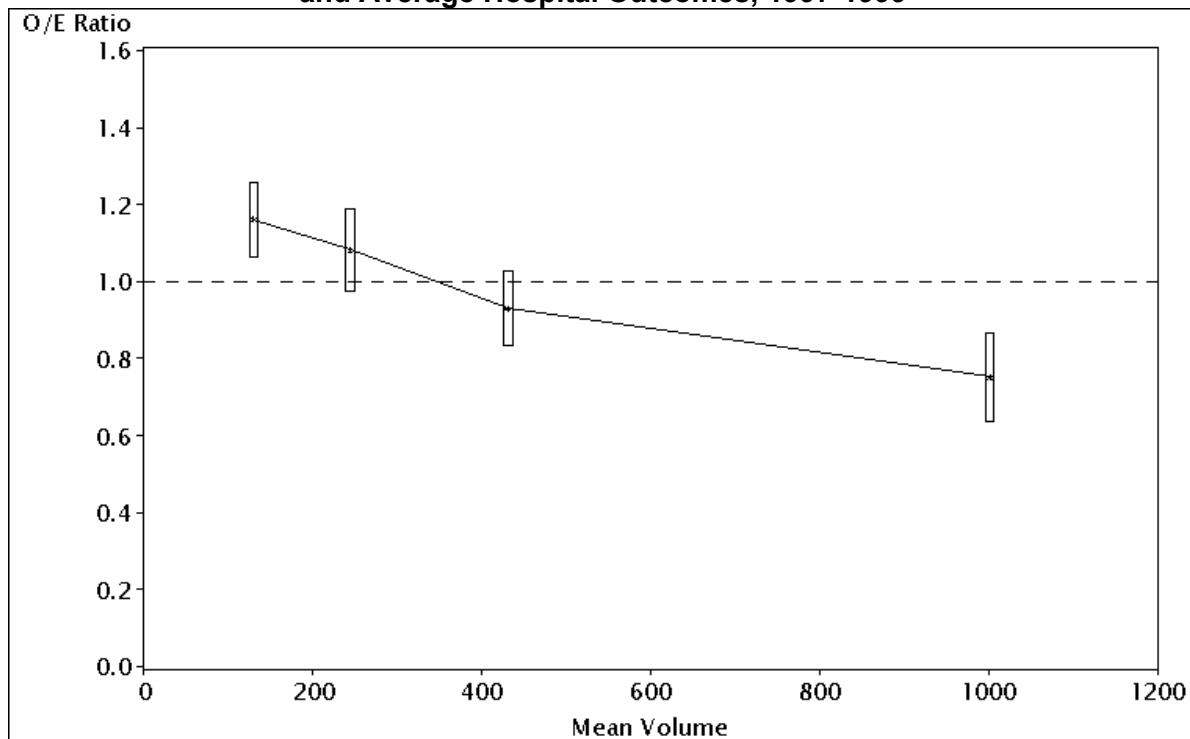
¹¹ This number differs slightly from the observed mortality rate of 2.76% for CCMRP participating hospitals reported elsewhere in the report. The rate of 2.73% is based on OSHPD patient discharge data (utilizing ICD-9-CM codes to determine isolated CABGs), while 2.76% is based on data submitted directly to CCMRP by each participating hospital (using a clinical definition of isolated CABGs).

that perform a higher volume of coronary bypass procedures achieve better outcomes—meaning they tend to have a lower death rate as compared to lower volume hospitals. The California CABG data provide a unique opportunity to examine whether there is a relationship between surgical volume and in-hospital mortality. This is particularly important in California for two reasons. First, California has a large proportion of low volume institutions compared to other states. For example, only 21% of the 33 hospitals performing bypass surgery in New York in 1999 performed fewer than 300 cases annually. However, 80% of California's 119 hospitals that provided bypass surgery in 1999 performed fewer than 300 cases annually. Second, we do not have risk-adjusted outcomes data for 49 of the 119 California hospitals that perform CABG. In the absence of outcomes data, the annual volume of bypass surgeries a hospital performs is one of the few proxy measures of performance available to the public.

The CCMRP analysis showed that as volume increases, risk-adjusted mortality decreases (a statistically significant relationship). Wide variation in performance among lower volume hospitals (i.e., those with *300 or fewer* cases annually) as compared with higher volume hospitals was also found.

As shown in Figure 1, the two highest volume groups (*300-599* cases and *600 or more* cases) had significantly lower mortality when compared to the lowest volume group (*200 or fewer* cases annually). In addition, the highest volume group (*600 or more* cases) had significantly better outcomes than the second group (*200 to 299* cases annually).

Figure 1: Relationship Between Average CABG Volume and Average Hospital Outcomes, 1997-1999



The analysis of the 1997-1999 CCMRP data supports findings from other studies that risk-adjusted in-hospital mortality and volume are related. While it is true that, on average, smaller volume hospitals tend to perform worse than larger hospitals and experience wide variation in performance, the **All Quarters** results demonstrate that low-volume hospitals can achieve good outcomes. A more detailed description of the volume-outcome analyses can be found in ***The California Report on Coronary Artery Bypass Graft Surgery 1999 Hospital Data: Technical Report***.